Claims

1. A robot manufacturing facility including at least one robot for acting on a workpiece or intermediate product of a pre-calculated shape and dimensions at a pre-calculated position and orientation relative to a reference frame, the robot including a body or base structure, at least one member movable with respect to said body or base structure for acting on such workpiece or intermediate product, means for effecting such movement and sensing means for sensing the position of said member, the last noted means including means for sensing the position of the workpiece or intermediate product relative to the robot or to said member thereof and means for controlling the movement of said member relative to said body or base structure according to a predetermined program, modified in accordance with signals from said sensing means, whereby the robot is able to compensate for departures from said pre-calculated values of the position and orientation and/or shape and/or dimensions of the workpiece or intermediate product.

2. A facility according to claim 1 wherein said sensing means includes light sensing means .

3. A facility according to claim 2 wherein a laser light source is carried by the robot and said sensing means includes means for detecting laser light, from said source, reflected from the workpiece or intermediate product.

4. A facility according to any preceding claim including continuously moving conveying means for moving successive workpieces or intermediate products through a plurality of work stations in sequence and wherein said

robot is located at a said work station and is arranged, during an active part of a work cycle thereof to effect, in relation to each said workpiece or intermediate product passing through the station, a primary movement corresponding to the mean velocity or rate of progress of such workpiece or intermediate product through the work station, and a superimposed, secondary movement determined by positioning errors or discrepancies determined by said sensing means.

5. A facility according to any preceding claim wherein said sensing means is located on the part of the robot, (herein also termed the "end effector"), which directly acts on the workpiece or intermediate product or on a part as close as possible to the first-mentioned part.

6. A method of programming an industrial robot, comprising developing a 3D virtual model of a workpiece or intermediate product, determining, on a virtual basis, required movements of a robot tool relative to such model for a manufacturing procedure to be carried out thereon, providing to a computer program data defined by said 3D virtual model and said virtual required movements, and controlling a real robot, in a real workshop/factory space in relation to a real workpiece or product, the real robot being provided with sensing means for sensing the positions relative to a fixed datum of such robot of key parts of such product identified by said sensing means in conjunction with said program and the progam being arranged to control the moving parts of said robot to reproduce the predetermined movements of the same, relative to the workpiece.

7. A method according to claim 6 including providing a display, in real time, of the operation of such virtual 3D model.

8. A method according to claim 6 wherein said program is arranged to adjust the movements of the robot to allow for sensed variations in dimensions or shape of individual said workpieces.

9. A method according to claim 6 or claim 7 wherein the real robot is arranged to sense bulk movements of the workpiece relative to a fixed reference frame during a work cycle and the computer and program are arranged to derive, over successive nominally identical work cycles on successive nominally identical workpieces, a set of average values representing a mean pattern of such movements during a mean such work cycle, and to apply during each work cycle, superimposed corrective movements in accordance with departures from the mean size, shape and positioning of the respective product from cycle to cycle as sensed by said sensing means.

10. A method of setting up a manufacturing facility, such as an assembly line, comprising setting up, within a computer, in terms of corresponding sets of data, a virtual factory in virtual manufacturing premises with dimensions corresponding to the real premises available, virtual machinery comprising data as to dimensions , to positioning, movement and timing of such machinery, and virtual personnel with corresponding data as to dimensions, limits of safe movement, speed of movement and the like and adjusting the data which is variable and thus represents degrees of freedom of the facility to arrive at an efficient workable arrangement.

11. A method according to claim 10 including providing a visual display of the operation of the virtual factory.